

Cloud Storage

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MIS 304 - Fall 2011
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12/13/2011

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Overview

During this semester, we learned that successful businesses set themselves apart by utilizing information in an intelligent and effective manner with the help of technology. In chapter 9, *Business Intelligence Systems*, we learned that information systems generate huge amounts of operational data that contain patterns, relationships, clusters, and other information that often influence the decisions made by management, especially in the areas of planning and forecasting (Kroenke, 2011). Business intelligence systems produce such information from operational data. For businesses, being able to forecast is crucial as they develop strategies to have a competitive advantage and gain market share over other companies. In 2009, it was estimated that 12,000 gigabytes of data was created and stored per person worldwide (Kroenke, 2011). First, in order for any company to be able to analyze the data, it has to be stored somewhere that is both reliable and easily accessible to the company. So where do companies store their data in order to obtain the accurate data needed to forecast efficiently? The majority of the companies currently use servers located on site, housed in the same physical building as the corporation. A new way to store data has emerged that combines reliability and accessibility and it has been growing in popularity as a result, this solution is called cloud storage.

According to SearchSotorage.com, “cloud storage is a service model in which data is maintained, managed and backed up remotely and made available to users over a network”. There are three kinds of cloud storage management to choose from: Public cloud storage, Private cloud storage, and Hybrid cloud storage (Cloud Storage, 2011). The public could is best used for unstructured data, the private could is used by users with more need for customization and more control over their data, the hybrid could is a combination of the private and public cloud for the users that have a need for both types (Cloud Storage, 2011). Any user can customize cloud

storage, whether it would be for a single user, small company or large company. The company would need to know exactly what the needs of the business are in order to assess the best use for cloud storage. Cloud storage has multiple benefits and some drawbacks. The purpose of this paper is to provide you with an analysis of the cloud storage from its beginning to what the future holds for this new way to store data.

History of the Cloud

The cloud concept that has recently become the technological hot topic, is actually very old. It has roots dating back to the 1950's and 1960's. Computer scientist John McCarthy has been credited as one of the founding fathers of the cloud computing concept.

In 1961, he was the first to publicly suggest (in a speech given to celebrate MIT's centennial) that computer time-sharing technology might lead to a future in which computing power and even specific applications could be sold through the utility business model (like water or electricity). This idea of a computer or information utility was very popular in the late 1960s, but faded by the mid-1990s. However, since 2000, the idea has resurfaced in new forms (see application service provider, grid computing, and cloud computing.) (Lxkp, 2011).

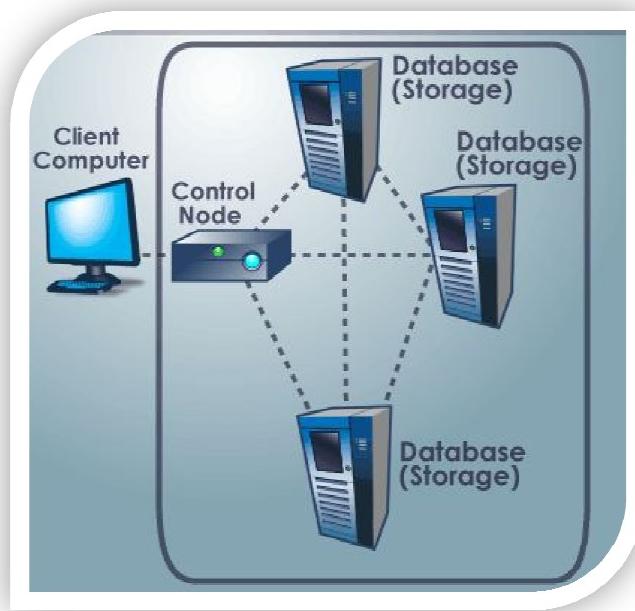
A fellow computer scientist, J.C.R. Licklider, is also credited as one of the founding originators of the cloud concept. The idea of an "intergalactic computer network" was introduced in the sixties by J.C.R. Licklider, who was responsible for enabling the development of ARPANET (Advanced Research Projects Agency Network) in 1969. His vision was for everyone on the globe to be interconnected and accessing programs and data at any site, from anywhere, explained Margaret Lewis, product marketing director at AMD. "It is a vision that sounds a lot like what we are calling cloud computing" (Weekly, 2009).

The cloud concept wasn't able to take off in the 1950's and 1960's because of technological limitations. Unfortunately, computer hardware and internet data speeds could not support the amount of data users wanted to send and receive. During the 1990's, technology would finally begin to improve and because of that, it began to satisfy the requirements needed to start bringing cloud computing to life. Cloud computing for the masses had finally arrived.

Cloud storage is a subcategory of the very complex cloud computing idea. It is a service model in which data is: maintained, managed and backed up remotely and made available to users over a network (typically the Internet). FilesAnywhere.com was one of the first companies to offer the cloud storage service. Their cloud storage service enabled users to store data on their servers from anywhere at any time, while also being able to retrieve the data from anywhere at any time. FilesAnywhere.com would be a pioneer in the cloud storage business and many companies would follow suit.

How Cloud Storage Works

At the simplest level, cloud storage can just be one user with access to one server. A user would upload his data through a terminal and store it on a server for safe keeping. In a scenario where that server was to malfunction, retrieving your data files would be impossible task until that server came back online. From a customer standpoint, this system would be highly ineffective as it would be unreliable and consumers would reject such an unreliable product in the marketplace. For the idea of cloud storage to be a feasible business, the simplest level of cloud storage would have to be expanded immensely to address the issue of reliability



Cloud storage is achieved through following the concepts of redundancy and repetition.

Without these concepts, cloud storage would be very difficult, if not impossible to exist.

Redundancy is really the core of cloud storage. Cloud storage at its basic level is just backing up data enough times so that the chance of losing that data becomes nearly irrelevant. Having multiple data servers to store data decreases the chances of losing data. A single data server store data is good, but ten data servers is a lot better.

Data centers are known to house several, even hundreds of data servers. Along with multiple data servers come multiple power supplies. Having all data servers on one power supply would counteract the use of having multiple servers. If one power supply were to power all the servers in a network, and for some reason it went offline, all the servers on that network would go down, rendering the entire network inaccessible. To combat this issue, servers are divided into groups and each is given their own power supply. By doing so, you lessen the chance of all your

equipment going offline. Having multiples of equipment solves half the problem of cloud storage.

The other half is what to do with all the user data.

Through the use of an operating system, all servers are able to act as one, even though they are made up of many. This is where repetition comes in to play. Each server is at the same time, separate but the same. All information on each server is the same. Repetition is the key factor here. User data is copied and distributed to each server. The data servers each receive their own copy of the data. If one copy is changed on a server, all copies are changed to reflect that on the rest of the servers. Having the same information on each server along with redundant equipment is how cloud storage is able to function.

The cloud storage concept is a great new technological advancement that will help customers safely and reliably store their data. With multiple data servers and multiple copies of information, companies are able to hedge their bets against the loss of data and server downtime. Companies will no longer need to house their own special equipment for their own data. They can outsource this process to cloud storage businesses and save money and time.

Benefits to Cloud Storage

Cloud storage benefits are low cost, easy to access, data recovery, and flexibility. Multiple users can see these benefits, below is a summary of the different benefits of cloud storage from a single user to large size company.

The Apple company is one of the best know companies around the world, a great innovation the company has created is the iCloud. For Apple users this is a great solution not only to store data but also to share data amount all of the Apple products.



Devices are added unto the iCloud and then the data can be accessed from any of the Apple devices. These devices can be your iPhone, iPad, iPod touch and PC etc. All is done wirelessly, the devices do not need to be connect to each other in order to have access to the data in the iCloud.

Once the data is uploaded to the iCloud, the data is downloaded to all the devices (What is Icloud by Apple, 2011). However, only the devices using the iOS 5 can access the iCloud services. For the fortunate user of the iOS, the best part of the iCloud service is the 5GB of free storage space (What is Icloud by Apple, 2011). Another great benefit for using the iCloud is the service of backup, a copy of all your data will remain store with Apple. In case that you lose any of your data then that you can get back that data through Apple backup service (What is Icloud by Apple, 2011). As a student the backup service is great, as we all have suffer the lost of data, you maybe just finished your project when the computer crashes, resulting in the lost of the document you just created. With the iCloud backup, we can feel more secure knowing that we can recover such valuable data in situations such as these.

For single users that do not use the Apple devices there are other sites that provide cloud storage for little to no cost. Rackspace "Cloud Files" is one of the most popular and simplest cloud storage solution offered today, and it only costs 15¢/GB. Another great service is Livedrive, which has "rapidly grown to store more than 10 billion files for its worldwide customers and is growing at a rate of over 20 million files each day" (Cloud Storage Providers).

For larger companies, the benefits are greater than a single user because of the cost saving in the IT department. Ms. Comsa interviewed Jeff Bell, director of corporate marketing at Zetta, her interview consisted on reasons why an enterprise should consider cloud storage, the reasons Mr. Bell provided were: instant, automatic "backup", continuous security and protection of your data, easy access to your data whenever and wherever you need it, scalability, and the low cost of ownership (Comsa, 2011).

The first benefit mentioned by Mr. Bell is instant automatic backup. In short, it functions similar to the Apple's iCloud service. The data is sent to the cloud for storage back up, eliminating the need to save the data in CDs, external hard drives, or servers.

The second benefit is security and protection from theft or natural disaster (Comsa, 2011). When these things happened the lost of data is one of the biggest concern for the company and it can potentially bring a company to its knees. For instance, when a company loses data about their customers, such as the customers address, it can be disastrous for the company. The customers address can be use for billing and or shipping, and when a company does not know where to ship or send bills, the company loses revenue. The company can potentially ship order to the wrong address or not sent at all. This type data lost can cost to company customers, time, and money.

During natural disaster, a company can be out of power for more than three days. According to article *The Cost of Lost Data* it is estimated that “a company that experiences a computer outage lasting for more than 10 days will never fully recover financially and that 50 percent of companies suffering such a predicament will be out of business within 5 years” (David M. Smith, 2003). This report is alarming for any company, which is why the cloud storage has such a great value to the company. A company can be sure that their data is safe and secure in

the cloud, even when they are not physically housed in the same location as the business. It is easier to recover physical property than the precious data.

Another benefit mention by Mr. Bell is the cloud data can be easily accessed whenever or wherever the users are located. A personal experience on this concept was during the 2003 Cedar Fires in San Diego; my company was not able to process payment to their customers because the office was closed for three days. The company needed to process payments to their customers but were unable to do so because very few employees had access to the data needed to process the payments. The company ended estimating the pay amounts, causing overpayments, time lost, and frustration with their customers. With the cloud storage this issue could have been prevented, data would have been available to a lot more people creating better customer service.

One of the greatest benefits to companies when using the cloud is scalability, meaning the ability to expand to meet future needs. With the cloud, the company can increase user without increase their cost for their data storage. As the company grows, users needed to store more and more data, more servers are needed, more electricity needed to keep those servers cool. With the cloud, costs are reduced for maintenance and management of the servers and there is no need to change or add to the infrastructure.

In an interview between SearchStorage.com and Jeff Boles, senior analyst and director, validation services at Hopkinton, Mass.-based Taneja Group, Mr. Boles highlighter features cloud storage has over our standard data storage (local file storage systems):

[SearchStorage.com](#): Are there features cloud storage services offer that you can't get with local file storage systems?

Boles: I've mentioned a couple of items like this idea of data access from anywhere, which is great for follow-the-sun enterprises and such. But I think one of the biggest things you get from cloud storage vs. local file storage is extreme data protection. If you look at most of the

providers out there today, you would see multiple site replications of data, often with at least three copies. Such replication is also built on top of a foundation designed for data integrity. Just think about it. The issues that arise with data integrity at extreme scale are totally different than what you may be capable of in your data center; and the things providers have done to protect themselves against those issues may mean you can find your best data integrity in the cloud. For instance the Zetta guys like to tout the fact that they do all kinds of profile check summing, periodic data reading and rewriting, and more to protect against things like RAID write holes or just gradually deteriorating disk media. For the customer, what you get is this multisite data protection with extreme data integrity, and all that is delivered on top of the provider being off-site from your facility to begin with. When you add that to the low pay-as-you-go cost and the ease of use associated with things like extreme instantaneous scalability, deep data protection can multiply the value you get from storing data in the cloud. Why? Because once you have data out in the cloud you can often stop worrying about backing it up or protecting it (Boles, 2011).

Disadvantages to Cloud Computing

When it comes to cloud models there are certain aspects of the model that many companies are concerned about including security, data privacy, integrity of remote data and computations. Many companies may not want to hand over their data to an external organization to store, fearing that they may not have the right security software to protect the company's data. For an organization or company security of their data, protection is the number one priority. While having remote servers is not a new concept but recent development of having cloud storage as a path forward for doing business requires a careful look at data privacy. When it comes to reasons given as to why organizations avoid cloud storage security is the top reason. By handing over any business or company's data to an external provider will

be an alert to most business owners. In adopting the cloud storage models of doing business, companies have to rely on security features to allow these remote providers to provide guaranteed of secured information stored. Companies need to adopt a practical approach in implementing such cloud storage models. Vendors that are offering company solutions need to have a rigorously guard to protect the company's data. Companies may need to give up some control over the data, which may lead companies to receive the cost economies that are accessible.

Cloud computing is based on the service provider ensuring that their infrastructure is secure and company's data and applications are protected. In addition, the end-user or client must ensure that the provider has undertaken proper security measures to protect the information (Wang, 2009). Through the perspective of data security, cloud computing predictably poses new challenges in security threats for many reasons. For instance, established cryptographic primitives for the purpose of data security protection cannot be fulfilled directly due to the user's loss control of data or cloud-service providers temporarily went down. Therefore, verification of correct data storage in the cloud must be conducted without explicit knowledge of the whole data. It can be very complicated when considering various kinds of data for each user stored in the cloud and the problem of verifying accuracy of data storage of the cloud.

Cloud computing is not just a third party data warehouse. Rather, the data stored in the cloud may be frequently updated by the users consist of using insertion, deletion, appending, or modifications. To ensure storage correctness under dynamic data is update and information is being stored and secured. However, this type of vital feature can make a company's integrity ineffective and could demand for new solutions. In most cases, the deployment of cloud

computing is driven through most data applications running in a simultaneous, cooperated and distributed manner. The cloud storage is redundant and still in process of making the infrastructure more reliable. Therefore, distributed protocols for storage correctness assurance will be of most essential in achieving a robust and secure cloud data storage system in the real world.

Cloud computing companies will need to find ways to protect client privacy. One way is to use authentication techniques such as user names and passwords. Another is to employ an authorization format each user can access only the data and applications relevant to his or her job (Strickland, 2011). In addition, the best practice of the cloud model is a repeatable process of designing and managing the Information Security aspects of Cloud Computing. According to CloudBestPractices.info, they aggregate and distill recognized industry standards, such as NIST and the Cloud Security Alliance, into a set of consulting best practices in the following main areas:

- Trusted Cloud - Ensure the integrity of the hosting environment.
- Cloud VPN - Secure the connection between users and Cloud applications.
- Trust Frameworks - Enable secure data communication between Clouds.
- Cloud Privacy - Audit tools to ensure information is stored in line with privacy laws.

The maturity model provides a framework that can provide a very helpful and practical toolset for planning and implementing Cloud solutions. It can specify work items and help identify vendors and their related capabilities (Cloud Security Model, 2011).

Pricing

In the recent years, cloud storage is becoming overwhelmingly popular and considered a must have technology in the IT world. Many companies like Apple and Google are also making the cloud available to their customers for personal use. However, just because a product/service is considered must have, it does not mean it is suited for everyone. Before a company or personal use customer makes a decision on purchasing a cloud service, they must understand the pros and cons, which were mentioned earlier. In addition, there are several precaution and consideration that they should take when making the final decision, which are the company's or personal needs, performance, and data protection expected from the service.

First and foremost, the IT personal will consider if this technology will fit the needs of the company. They will consider how much storage space is needed for the time being and in the future for the company and if the budget will allow for the plan to continue. Many companies will discover that cloud storage service is significantly much less than if they were to employ all of the necessary technology onsite and then hire the staff to maintain it. However, “the cheapest cloud storage solution does not offer the best service when it comes to protecting business data” (Networks, 2011). The service will improve the productivity and save money for a company immediately and in the future. If this is not case, following through with the idea maybe a bad one as time and money, which could be used for more productive work, is lost during the process of reallocating the data to the new server for no beneficial implications for a company. Also, they should not have to feel pressured to join the cloud to keep pace with the competition or with current technology hype, which can be a huge mistake to a company as they may realize the affordability of the service was not within their means or the features did not meet to their expectations.

Once a company decides to purchase cloud storage, their next step would be researching on the performance of the server providers. A major detail to be considered is how fast of a transfer rate is needed. Most cloud service providers only have an upload transfer rate of 2-3 Mb/sec, which is fine for backing and archiving files but is likely not sufficient enough for production data (Hazard, 2011). For a higher price rate, some providers do have faster transfer like fiber optic cables available for clients, who do need the faster, upload speed for larger data. The download speeds from these providers' ranges from 2.2 MB/s to 7.7MB/s, which means downloading 1 GB or 300 songs, is estimated around 1 hour to 15 minutes. The next performance consideration is the consistency and reliability of the server(s). An unstable server is a liability and can cause grief to clients when the link to the servers is dropped or down due to maintenance. Although, “cloud providers try to address this concern through redundancy techniques, there is still the possibility that an entire system could crash and leave clients with no way to access their save data” (Strickland, 2011). The best solution to finding the right provider is to actually test out the servers before committing. Most providers offer a two week test trial of their service. A company will be able to test different loading and traffic scenarios on the cloud server during that time period.

When searching for a suitable provider, data protection features is high on the priority list as many companies aren't likely to entrust a provider with their valuable information if there is no guarantee access or protection. Disaster recovery is an important feature that most providers offer. The service provider would create a plan for a client to recover from in case there is a catastrophe event that causes all data to be lost at the worksite, such as: power outage, earthquakes, or any other natural disasters. With this plan, client would be well prepared for such events and downtime for recovery would be only at a minimum or none at all (Networks, 2011).

In addition to a disaster recovery plan, a provider should have a comprehensive backup system. A company that is “relying on applications such as Microsoft Exchange for email services and SQL database, will want their cloud provider to be capable of providing automated backup onsite, fast file restoration, and efficient email and database recovery services” (Networks, 2011). The last important feature in data protection is security; as mentioned earlier, there were many concerns in recent years about the weak security protection put in place in servers by their providers. However, providers have invested much time and money in techniques, such as encryption, authentication processes, and authorization practices, to secure their servers and limit the possibility of data theft or corruption (Strickland, 2011). Even with all the protection, there is still a chance that a hacker will be able to find a back door, access point to the data, or they can even attempt to steal the physical machines, which is where the data is stored.

There are several different types of prices that a provider can offer depending on the amount of storage space and features needed. Cloud servers come in two different forms: virtual and physical. “A company can purchase a virtual server, which is a physical hardware may be shared with others, or time on a dedicated server, where there is only one “tenant” on that server” (Maitland & Torode, 2010). Here is an example of the breakdown prices:

TABLE 1: Basic Cloud Server Pricing for Virtual Servers					
	VIRTUAL MACHINE INSTANCE	BANDWIDTH IN	BANDWIDTH OUT	BACKUP	SUPPORT
RackSpace Cloud 1,024 MB/40 GB	\$06/hour or \$43.80/ month	\$0.08/GB	\$0.22/GB	\$0.15/GB	Included
Amazon EC2— Small server Linux	\$325/year, plus \$0.03/hour	\$0.10/GB	\$0.17/GB	\$0.15/GB/ month	\$0.015/ instance/ hour
GoGrid 1,024 MB/ 60 GB	\$0.19/hour	Free	\$0.50/GB	\$0.15/GB	Included

SOURCE: FRANK CHANDRIST

(Maitland & Torode,

2010)

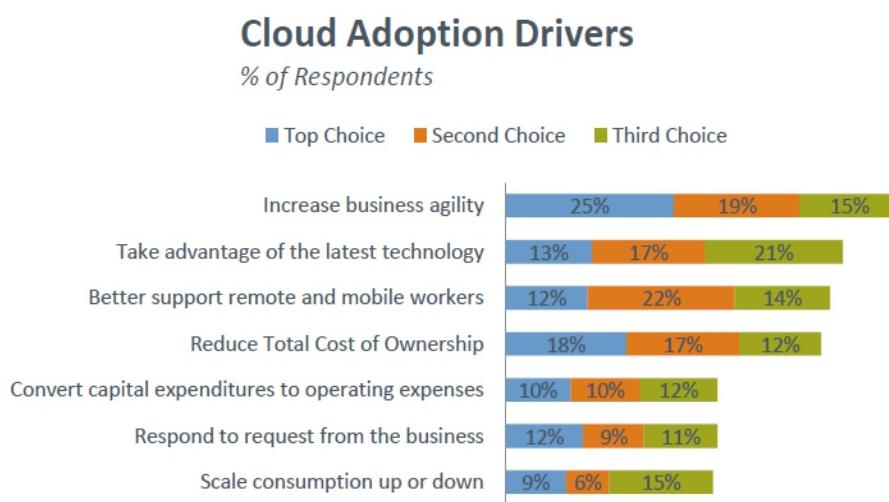
However, the example pricing does not show the full pictures of these services. Not all cloud services provide equal features in all their packages, as different service providers will fit different customer needs. To highlight this example, a company looking for an extra large amount of storage will benefit from a provider such as Amazon, which currently starts off their pricing at 14 cent per GB for the first TB. However, Amazon offers a discount to companies that increase their storage space overtime. In contrast, there are companies like IBM, which offers highest security protection to their clients with the downside of a higher rate for a smaller amount of storage space compared to Amazon. Overall, the IT team that does a well prepared research on cloud storage provider will be able to find the perfect one for their company.

The Future of the Cloud

After reviewing the analysis done, we have concluded that cloud storage has its benefits and is drawbacks, so what does that mean, what is the future for cloud storage? According to Mr. Kreisa “2011 was a year of figuring out what storage works best in what infrastructure, 2012 will be the year that innovation soars within the industry. (Kreisa, 2011)”. Mr. Kreisa has three predictions for the 2012; One: The software model will prove essential for storage; hardware will become increasingly insufficient; Two: Enterprises will provide anytime, anywhere access to data; and Three: Enterprise replication standards will be adopted in the cloud. For prediction number one he thinks that hardware will become impractical and that the software model for storage will prove essential. However, he acknowledges that this may not always be the case but he also added that there is a projected compound annual growth rate of 28.9 percent for cloud storage from last year on to 2015, therefore hardware will lose in the end. For prediction number two, he stated that due to customer needs to access and store data from anywhere business will be force to address the issue of maxing out on their current infrastructure and come up with

creative solutions. For prediction number three he expects business to “accelerate the adoption of data replication standards developed in the enterprise data center to the cloud” (Kreisa, 2011).

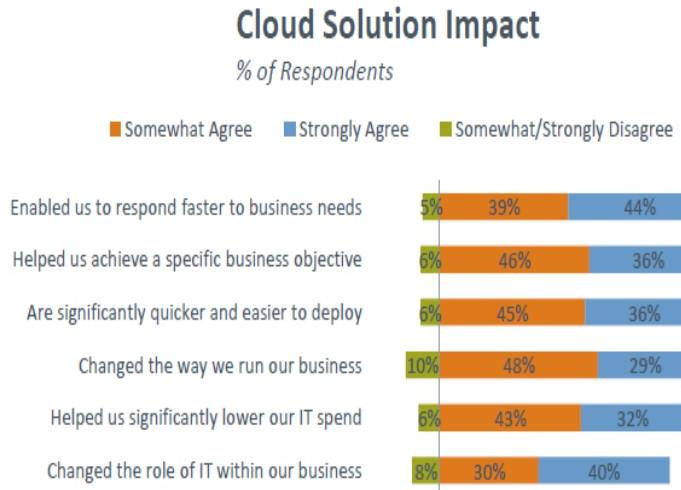
Mr. Kreisa predictions are quantified in a statistical analysis done by Appirio, for companies who adopted cloud storage (Appirio, 2010). Appirio survey companies with over 500 employees who had implemented some type of cloud storage management. Appirio received 155 responses from the survey by people who are directly involved or providing recommendations about cloud solution decisions. One of the advantages mentioned previously was reduction in cost, mainly for the IT side but Appirio found that cost savings are seen not only in IT but also in other areas of the organization.



Reduction in IT is one of the top reasons why cloud storage is adopted business agility has become the #1 reason. The graph to the left shows the results of the survey conducted when asked to rank the reason why the business uses cloud storage.

These results are in line with the predictions reported by Mr. Kreisa, companies are noticing that the cloud can provide them with flexibility and the ability to access their data anywhere. Appirio also reported that expectations have shown results, see graph below.

The graph on the rig reports that “more than 80% of companies that have adopted cloud applications and platforms say that they are now able to respond faster to the business and achieve business objectives. They’ve also found these solutions easier to deploy and cheaper to maintain.



Note: Does not total 100% because chart excludes those answering "Neither Agree Nor Disagree"

The cloud has helped change IT’s role in the business—70% of adopters say that IT is now seen as a business enabler and 77% say that cloud solutions have changed the way they run their business (Appirio, 2010”). However, Appirio reported that there is room for improvement such as “prove the security, manageability, integration, Reducing SaaS silos, and data quality (Appirio, 2010”). Businesses wait for these improvements in the future. Only time will tell how fast cloud management can fix these issues and how successfully it will be.

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